How the Use of Internet and Multimedia Technology in Education Correlates with Student Engagement

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Received in August 2016

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Abstract. This research was performed to investigate the correlations between the use of Internet and multimedia technology by university teachers and four styles of student engagement. The study was based on the data collected in 2015 from 11 universities (the total sample included 16,893 Bachelor's and Specialist's degree students) as part of the Trajectories and Experiences of Russian University Students Project. The findings support the hypothesis about a positive correlation between the use of Internet and multimedia technology, on the one hand, and student engagement in learning and interacting with teachers and peers, on the other hand. The more widely multimedia technology is used by teachers, the higher academic and social engagement of students and their commitment to meet teachers' high requirements is—and the lower their engagement in academic nonperformance is.

Keywords: higher education, Internet, multimedia technology, student engagement, Learning Management System, PowerPoint presentation.

DOI: 10.17323/1814-9545-2016-4-59-83

The widespread use of the Internet and multimedia technology observed today in many spheres could not leave university learning untouched. Some teachers use new technology opportunities to diversify the learning process and increase effectiveness. Besides, universities actively implement new education formats, such as learning management systems (LMS), online courses, blended learning, etc. Meanwhile, it remains unknown how the integration of the Internet and multimedia into learning affects student performance. Some researchers believe that digital technology in education can not only result in new practices that will be simple alternatives to existing ones, but also transform the very learning process significantly [Coates 2006], as learning tools influence thinking patterns [Turkle 2004]. In this article, we are trying to find out how the use of new technology

in education is associated with various aspects of university learning activities.

One of the trends in the research on the influence of new technology on university student performance is to study the effectiveness of PowerPoint-based lectures. In particular, Jennifer Clark shows that the use of PowerPoint presentations stimulates the interest of students in the information presented and boosts their attention by providing visual stimuli [Clark 2008]. However, this effect can only be achieved if the presentation is dynamic and uses different text formats and examples. In addition, the research on the influence of e-presentations on academic performance provides no unambiguous implications: some studies report positive effects [Reinhardt 1999; Parks 1999; Lowry 1999], while others do not [Szabo, Hastings 2000; Rankin, Hoaas 2001].

The abovementioned publications represent early studies conducted when e-presentations were first introduced in education. The practice has spread widely by now, and some researchers believe that PowerPoint presentations do not provide the same initial effect anymore. For instance, it was empirically proven that student assessment of PowerPoint presentations' influence on learning and peer interactions correlated with a perceived novelty of this way of presenting information [Burke, James 2008]. Perception of e-presentations may vary depending on the course and material delivered [Burke, James, Ahmadi 2009]. It is also affected by the speaker's appearance and manner of speaking [Farwell 2005]. Therefore, the mere act of using PowerPoint presentations does not boost engagement or academic performance, because the effects depend largely on how the format is used by a teacher. According to some researchers, searching for ways to convert the overall positive attitude of students toward presentations into improved learning and, hence, performance is a key pedagogical challenge [Craig, Amernic 2006].

Another avenue for research in this field is exploring the popularity and effectiveness of learning management systems (LMS). According to the 2006/07 statistics, over 90% of American universities [Hawkins, Rudy 2007] and 95% of British higher education institutions [Browne, Jenkins, Walker 2006] installed and provided LMS for use by teachers and students. However, active implementation of such systems requires that teachers not only develop LMS skills but also change their teaching habits to encourage students to use the system for learning and interacting with teachers [Topper 2003; Dougiamas, Taylor 2003; Bender 2005; Gaensler 2004]. A number of studies have shown that students and instructors assess their LMS experience as overall positive [Lonn, Teasley 2009; Naveh, Tubin, Pliskin 2010]. For instance, students report that LMS facilitate access to study materials [Lonn, Teasley 2009], making the learning process more flexible and less restricted to a specific time and/or place [Piccoli, Ahmad, Ives 2001]. Yet, not all students are able to benefit from using LMS, as it depends

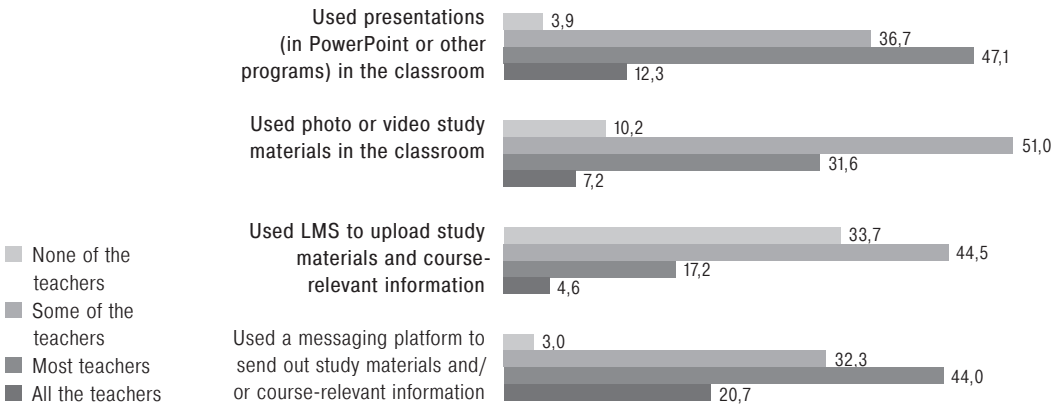
on the way they implement the learning tools [Lust et al. 2012]. There are also studies showing that LMS are only considered effective by university administrators, while students and teachers perceive them as a barely useful supplement to the conventional teaching practices [Lai, Savage 2013]. Such findings may be the result of student and teacher resistance to innovations in education. On the whole, researchers tend to summarize that the use of LMS in education transforms considerably the traditional learning and teacher-student interaction patterns [Coates, James, Baldwin 2005; Coates 2006; Beer, Clark, Jones 2010], but there still has been no unambiguous data on how these transformations affect academic achievements and university experiences of students.

Some empirical studies also demonstrate that teachers can increase student engagement in learning not only by using ICT in the classroom but also by encouraging students to use the Internet and multimedia options. Based on the data obtained in the National Survey of Student Engagement (NSSE) conducted in the USA and Canada in 2003, researchers conclude that the use of IT by students for learning purposes correlates positively with their engagement and interaction with teachers [Laird, Kuh 2005]. Another study reveals that using Twitter for learning purposes has a positive effect on student engagement and GPA [Junco, Heiberger, Loken 2011].

Russian researchers address the effectiveness of using multimedia and Internet technology in education as part of pedagogical experiments, among other aspects. In particular, Zanozin refers to the results of assessing the effectiveness of e-learning packages in pedagogy and in the discipline called Teaching Techniques & Psychological Workshop. The students working with these electronic resources were found to score better in the final test than those who used printed materials [Zanozin 2011]. The multimedia packet developed for the year-long ecology course offered by Tomsk State University also proved more effective than the traditional teaching methods [Rudenko 2003]. Similar results were obtained in other Russian experimental studies, such as [Alexandrov 2009; Dmitriev 2011; Meshcheryakov, Dmitriev 2011].

Although many teachers and students assess positively the teaching and learning effects of information technology [Lonn, Teasley 2009], most instructors remain faithful to traditional formats of lectures and seminars. During the survey conducted under the Trajectories and Experiences of University Students in Russia project (we will dwell on it in the Data and Method chapter), only 22% of students reported that their teachers used LMS to deliver study materials and course-related information. Less than two-thirds of respondents agreed that most (or all) teachers used e-presentations in the classroom and a messaging platform to communicate with students, and only 39% indicated that many teachers used photo and video content for teaching purposes (Fig. 1).

Figure 1. **The use of the Internet and multimedia technology by teachers**,% (*N* = 16,893)



This paper investigates the influence that the use of new educational technology by teachers has on student engagement in Russia. According to the approach proposed by George D. Kuh [2007], we understand student engagement as involvement in effective educational practices. Using student engagement as an indicator of academic performance when exploring student learning activities has a number of advantages [Pascarella 2001, Ewell, Jones 1993; 1996]. By measuring student engagement, we can assess various aspects of the current learning situation. It has been established that engagement affects educational achievements, which proves that the relevant indicators are valid [Maloshonok 2014].

Conceptual Framework

To analyze the influence of using new educational technology by teachers on student engagement in the learning process, we rely upon the behavioral approach that formed the basis for the development of machine learning systems. According to Skinner and his ideas of operant conditioning, people and animals learn by running into contingencies that act as reinforcers [Skinner 1965]. The learning process is more intensive in educational environments, where teachers arrange special contingencies that expedite learning to hasten the appearance of certain behavior and increase learning effectiveness [Skinner 1963]. In machine learning, some contingencies of reinforcement may be provided by automated devices. Therefore, Skinner suggests that teachers can use special teaching machines to optimize the learning process [Skinner 1965]. Based on these theoretical assumptions, we can suggest that the use of multimedia and Internet technologies allows teachers to enrich and diversify their sets of reinforcement contingencies, boosting effectiveness of learning. The learning process transformations will be reflected in student behav-

ior as responses to the new stimuli, thus increasing student engagement. Now, we can formulate the research hypothesis as follows: the use of the Internet and multimedia technology in education correlates positively with student engagement. Consequently, the proposed hypothesis contradicts the following statements: "The use of technology by teachers has negative or no effects on student engagement since students respond to interactive tools in the same way they respond to conventional teaching practices", and "The use of digital technology in education distracts students from actually learning, decreasing their engagement".

Data and Method

The empirical basis of the research was provided by data from the interuniversity project Trajectories and Experiences of University Students in Russia, collected from 11 Russian universities. Ten of them are involved in the Project 5–100 (Kazan Federal University, Lobachevsky State University of Nizhny Novgorod, National Research University Higher School of Economics, Tomsk State University, Tomsk Polytechnic University, Samara State Aerospace University, Peter the Great St. Petersburg Polytechnic University, Saint Petersburg Electrotechnical University, ITMO University, and Ural Federal University), and one is a federal university (North-Eastern Federal University). Links to the online survey were sent out to students' emails in spring 2015. In some universities, the links were sent to students' personal LMS profiles. The response rate varied from 5% to 40% across the universities. The total sample used for analysis included 16,893 students. The different response rates in different universities was primarily to do with the commitment of project coordinators who were in charge of the field stage (advertizing, engaging students and providing additional incentives, such as a lottery, etc.). Besides, the response rate depended on the overall student attitude towards surveys and the level of the relevant culture in a specific university. Some students are used to filling out questionnaires, but it may be a new experience for others. Sample representativeness was assessed depending on the year of study and the form of financing[1]. The difference in the response rate depending on the form of financing varies from 0% to 18% across the universities, and the difference determined by the year of study ranges from 4% to 42.8%. As we can see, the resulting sample does not represent all Russian universities, and not all specific university samples represent the general university population. It is also probable that the sample is biased towards more engaged students with better academic outcomes (Table 1, Addendum).

[1] These were the only two sample assessment parameters available, due to the limitations of statistical data collected by universities.

The use of the Internet and multimedia technology by teachers was assessed based on four indicators:

- Using presentations (in PowerPoint or other programs) in the classroom
- Using photo or video study materials in the classroom;
- Using LMS to upload study materials and course-relevant information;
- Using a messaging platform to send out study materials and/or course-relevant information.

The indicators were measured using a four-point rating scale: "None of the teachers", "Some of the teachers", "Most teachers', and "All the teachers" (Table 2, Addendum)

Student engagement styles

To assess student engagement, we used a number of indicators showing student involvement in various types of learning activities. To present the results in a convenient form, we grouped the abundance of indicators into four engagement styles using factor analysis (principal component analysis). Before shrinking the feature space to a few factors, we analyzed the validity and reliability of the indicators within each factor.

The factors analysis revealed the following student engagement styles[2].

1. *Academic engagement* (14 indicators, Cronbach's α = 0.904). This factor explains 44.74% of the variance of initial parameters and describes the degree of student involvement in classroom and extracurricular activities as well as in various types of intellectual activities during their university studies. This engagement style was assessed using the indicators measuring the frequency of students doing the following (factor loadings are given in brackets):
   – Participating in discussions and seminars (0.625)
   – Using ideas and concepts from different courses in classroom discussions (0.712)
   – Asking course-related questions in the classroom (0.619)

[2] Within the framework of this study, we first performed an explanatory factor analysis to determine the approximate typology of engagement styles. Next, we tested the indicators within each factor for validity and reliability using Cronbach's alpha. The indicators that lowered the overall reliability level were removed from analysis. After that, we constructed a factor model with one predetermined factor for each engagement style. Further on, we used the factor value obtained as a result of this analysis.

- Being highly interested in the subject, i. e. working on it more than required (0.560)
- Delivering reports or presentations in the classroom (0.556)
- Analyzing specific facts, terms and concepts (0.642)
- Investigating the methods, ideas or concepts and using them to solve training problems (0.677)
- Analyzing the arguments and the implications derived from them (0.757)
- Evaluating information, ideas or implications based on the reliability of sources and the accuracy of methods and arguments (0.719)
- Putting forward new ideas, developments and approaches (0.655)
- Using facts and examples to justify one's point of view (0.760)
- Implementing ideas and concepts from different disciplines when doing homework (0.750)
- Analyzing the data collection and interpretation methods used by other people and assessing the soundness of their implications (0.682)
- Reconsidering one's opinion on a specific situation after assessing the arguments of other people (0.605).

2. *Social engagement* (6 indicators, Cronbach's α = 0.759). This factor explains 45.83% of the variance of initial parameters and describes the degree of student involvement in interactions with teachers and peers to achieve one's educational goals. This factor includes the indicators showing how often students engage in the following:
   - Interacting with teachers personally: face-to-face, by telephone or email (0.723)
   - Discussing course-related ideas or concepts with teachers out of class (0.802)
   - Working together with a teacher on social or creative extracurricular projects (e. g. student organizations, student governments, etc.) (0.674)
   - Asking a teacher, teacher's assistant or tutor for assistance when needed (0.617)
   - Working on a group task or team project with peers out of class (0.616)
   - Assisting one's peers when preparing for classes together (0.608).

3. *Engagement in academic nonperformance* (3 indicators, Cronbach's α = 0.776). This factor explains 69.57% of the variance of initial parameters measuring the frequency of committing the following violations:
   - Handing in tasks after the deadline has expired (0.811)

– Coming unprepared to classes (0.877)
– Skipping classes without good reason (0.813).

4. *Commitment to meet the teacher's high requirements* (2 indicators, Cronbach's α = 0.669). This factor explains 75.13% of the variance of initial parameters and describes the tendency of students to make every effort to meet the teacher's requirements. The factor was calculated by measuring the frequency of students doing the following:
   – Making more effort than usual to succeed in the course due to the high requirements imposed by the teacher (0.867)
   – Redoing written work fundamentally at least once before handing it in (0.867).

The factors constructed correlate moderately with one another: the Pearson correlation coefficients are given in Table 3 of the Addendum.

Regression analysis results

Multiple linear regression analysis was used to identify correlations between the use of digital technology by teachers and student engagement in learning. Student engagement styles acted as dependent variables and the four indicators of the use of multimedia and Internet technology represented independent variables. Three regression models were constructed for each of the four engagement styles. Model 1 included only the dependent variable (manifestation of a specific engagement style) and four independent variables as predictors. Similarly, Model 2 included the dependent and four independent variables but also the following control variables: gender, form of financing, field and year of study. Model 3, apart from the control variables mentioned above, also included variables showing which university students study at. The choice of control variables is explained by the fact that student engagement and learning activity normally depend on both individual characteristics (gender, having a public-funded place or not, year of study) as well as disciplinary (field of study) and institutional university-associated factors. The correlation coefficients for the dependent variables in the regression are given in Table 4 of the Addendum.

While constructing each regression model, we used Variance Inflation Factors (VIF) to measure how much multicollinearity inflated the variance of the estimated regression coefficients. VIF varied from 1.129 to 1.533 for all the considered predictors in all the models constructed, which means that all of the predictors were safe to use.

The regression models constructed for the "academic engagement" dependent variable show that all the four indicators of the use of digital technology in education correlate positively with academic engagement (Table 1). Using photo and video study materials in the classroom and using a messaging platform to interact with students appear to be the most powerful factors. As we add the control varia-

Table 1. **Regression coefficients for the model with academic engagement as the dependent variable**

	Model 1		Model 2		Model 3	
	Standardized (Beta) coefficient	Significance	Standardized (Beta) coefficient	Significance	Standardized (Beta) coefficient	Significance
Constant		0.000		0.000		0.813
Predictors						
Used presentations (in PowerPoint or other programs) in the classroom	0.076	0.000	0.057	0.000	0.050	0.000
Used photo or video study materials in the classroom	0.112	0.000	0.127	0.000	0.129	0.000
Used LMS to upload study materials and course-relevant information	0.02	0.000	0.022	0.008	0.045	0.000
Used a messaging platform to send out study materials and/or course-relevant information	0.148	0.018	0.134	0.000	0.079	0.000
Control variables						
Gender (male)	—	—	–0.027	0.002	–0.025	0.002
Form of financing (public-funded)	—	—	0.077	0.000	0.095	0.000
Field of study (exact sciences)	—	—	0.024	0.006	–0.019	0.035
Field of study (engineering)	—	—	–0.071	0.000	–0.158	0.000
Field of study (social sciences)	—	—	0.118	0.000	0.043	0.000
Year of study	—	—	–0.024	0.003	0.003	0.685
University 1	—	—	—	—	–0.008	0.525
University 2	—	—	—	—	–0.094	0.000
University 3	—	—	—	—	–0.046	0.000
University 4	—	—	—	—	–0.020	0.067
University 5	—	—	—	—	–0.077	0.000
University 6	—	—	—	—	–0.313	0.000
University 7	—	—	—	—	–0.064	0.000
University 8	—	—	—	—	–0.074	0.000
University 9	—	—	—	—	–0.068	0.000
University 10	—	—	—	—	–0.019	0.061

Note: Dependent variable: academic engagement (factor value). Independent variables take on "1" if a respondent opts for "Most teachers" or "All the teachers" and "0" if he/she opts for "None of the teachers" or "Some of the teachers". Model 1: $R^2 = 0.069$, adjusted $R^2 = 0.068$, standard error of the estimate = 0.965, Durbin–Watson statistic = 1.779. Model 2: $R^2 = 0.097$, adjusted $R^2 = 0.096$, standard error of the estimate = 0.951, Durbin–Watson statistic = 1.808. Model 3: $R^2 = 0.153$, adjusted $R^2 = 0.152$, standard error of the estimate = 0.921, Durbin–Watson statistic = 1.946.

bles to the analysis, the adjusted R^2 grows from 0.068 to 0.153. Consequently, the indicators of the use of multimedia technology only explain a small proportion of academic engagement variance. However, the statistically significant regression coefficients observed in all three cases prove that there is a positive relationship between the variables, i. e. our hypothesis is confirmed.

The regression model constructed for the "social engagement" dependent variable also reveals a significant correlation between all the indicators of the use of multimedia technology and the factor manifestation, whether the control variables are included or not (Table 2). Based on the results obtained, we can assume that the more often technology is used in education, the more students involve themselves in interactions with teachers and peers to achieve their educational goals. Adding the control variables to the model increases the adjusted R^2, which the percentage of variance explained by the model, from 0.090 to 0.120. The low percentage of explained variance indicates that social engagement is mostly provided by other factors not included in the model. Nevertheless, the analysis results demonstrate a correlation between the use of multimedia technology by teachers and social engagement of students, thus confirming our hypothesis.

The following three regression models were constructed for the "engagement in academic nonperformance" dependent variable (Table 3). Analysis reveals significant negative correlations between the factor value and the two indicators: using photo and video study materials in the classroom and using LMS to upload study materials and course-relevant information—in all three models. Models 1 and 3 also demonstrate a significant negative correlation between using presentations and engagement in academic nonperformance. Therefore, using photo and video materials and LMS may contribute to decreasing the incidence of students violating deadlines, missing classes or coming unprepared to the classroom. Meanwhile, the indicators of the use of multimedia technology by teachers explain very little the manifestation of the nonperformance factor, as evidenced by R^2 and its growth from 0.005 to 0.059 after adding the control variables.

The last three regression models were constructed for the "commitment to meet teacher's high requirements" dependent variable (Table 4). As in the first two cases, the factor value correlates positively with all the indicators defined as predictors in all the models with the control variables included or not. Based on this observation, we can conclude that the active use of PowerPoint presentations, photo and video study materials, LMS, and a messaging platform to interact with students correlates positively with the effort that students make to perform better in order to meet the high requirements imposed by teachers. The adjusted R^2 grows insignificantly from 0.016 to 0.052 when the control variables are added, so the variance of this student engagement factor is only explained by the revealed correlations to a small extent.

Table 2. **Regression coefficients for the model with social engagement as the dependent variable**

	Model 1		Model 2		Model 3	
	Standardized (Beta) coefficient	Significance	Standardized (Beta) coefficient	Significance	Standardized (Beta) coefficient	Significance
Constant		0.000		0.000		0.000
Predictors						
Used presentations (in PowerPoint or other programs) in the classroom	0.048	0.000	0.040	0.000	0.037	0.000
Used photo or video study materials in the classroom	0.146	0.000	0.137	0.000	0.139	0.000
Used LMS to upload study materials and course-relevant information	0.101	0.000	0.108	0.000	0.117	0.000
Used a messaging platform to send out study materials and/or course-relevant information	0.130	0.000	0.130	0.000	0.101	0.000
Control variables						
Gender (male)	—	—	–0.025	0.002	–0.029	0.000
Form of financing (public-funded)	—	—	0.056	0.000	0.057	0.000
Field of study (exact sciences)	—	—	–0.020	0.017	–0.026	0.004
Field of study (engineering)	—	—	–0.021	0.042	–0.063	0.000
Field of study (social sciences)	—	—	–0.010	0.293	–0.033	0.002
Year of study	—	—	0.110	0.000	0.118	0.000
University 1	—	—	—	—	0.038	0.002
University 2	—	—	—	—	–0.049	0.000
University 3	—	—	—	—	–0.031	0.000
University 4	—	—	—	—	0.018	0.100
University 5	—	—	—	—	–0.003	0.780
University 6	—	—	—	—	–0.100	0.000
University 7	—	—	—	—	–0.014	0.130
University 8	—	—	—	—	–0.048	0.000
University 9	—	—	—	—	–0.030	0.007
University 10	—	—	—	—	0.007	0.455

Note: Dependent variable: social engagement (factor value). Independent variables take on "1" if a respondent opts for "Most teachers" or "All the teachers" and "0" if he/she opts for "None of the teachers" or "Some of the teachers". Model 1: $R^2 = 0.090$, adjusted $R^2 = 0.090$, standard error of the estimate = 0.954, Durbin–Watson statistic = 1.866. Model 2: $R^2 = 0.107$, adjusted $R^2 = 0.106$, standard error of the estimate = 0.945, Durbin–Watson statistic = 1.843. Model 3: $R^2 = 0.120$, adjusted $R^2 = 0.119$, standard error of the estimate = 0.939, Durbin–Watson statistic = 1.901.

Table 3. **Regression coefficients for the model with engagement in academic nonperformance as the dependent variable**

	Model 1		Model 2		Model 3	
	Standardized (Beta) coefficient	Significance	Standardized (Beta) coefficient	Significance	Standardized (Beta) coefficient	Significance
Constant		0.000		0.025		0.000
Predictors						
Used presentations (in PowerPoint or other programs) in the classroom	–0.032	0.001	–0.012	0.199	–0.021	0.025
Used photo or video study materials in the classroom	–0.042	0.000	–0.040	0.000	–0.033	0.000
Used LMS to upload study materials and course-relevant information	–0.022	0.007	–0.026	0.002	–0.027	0.001
Used a messaging platform to send out study materials and/or course-relevant information	0.010	0.224	0.015	0.064	0.012	0.157
Control variables						
Gender (male)	—	—	0.170	0.000	0.168	0.000
Form of financing (public-funded)	—	—	–0.042	0.000	–0.052	0.000
Field of study (exact sciences)	—	—	0.051	0.000	0.043	0.000
Field of study (engineering)	—	—	0.034	0.001	0.01	0.406
Field of study (social sciences)	—	—	0.012	0.232	–0.017	0.117
Year of study	—	—	–0.013	0.100	–0.001	0.897
University 1	—	—	—	—	0.098	0.000
University 2	—	—	—	—	0.118	0.000
University 3	—	—	—	—	0.014	0.124
University 4	—	—	—	—	0.155	0.000
University 5	—	—	—	—	0.158	0.000
University 6	—	—	—	—	0.139	0.000
University 7	—	—	—	—	0.056	0.000
University 8	—	—	—	—	0.117	0.000
University 9	—	—	—	—	0.138	0.000
University 10	—	—	—	—	0.068	0.000

Note: Dependent variable: engagement in academic nonperformance (factor value). Independent variables take on "1" if a respondent opts for "Most teachers" or "All the teachers" and "0" if he/she opts for "None of the teachers" or "Some of the teachers". Model 1: $R^2 = 0.005$, adjusted $R^2 = 0.005$, standard error of the estimate = 0.997, Durbin–Watson statistic = 1.854. Model 2: $R^2 = 0.040$, adjusted $R^2 = 0.039$, standard error of the estimate = 0.980, Durbin–Watson statistic = 1.920. Model 3: $R^2 = 0.059$, adjusted $R^2 = 0.058$, standard error of the estimate = 0.971, Durbin–Watson statistic = 1.958

Table 4. **Regression coefficients for the model with commitment to meet the teacher's high requirements as the dependent variable**

	Model 1		Model 2		Model 3	
	Standardized (Beta) coefficient	Significance	Standardized (Beta) coefficient	Significance	Standardized (Beta) coefficient	Significance
Constant		0.000		0.055		0.000
Predictors						
Used presentations (in PowerPoint or other programs) in the classroom	0.023	0.014	0.021	0.027	0.027	0.004
Used photo or video study materials in the classroom	0.052	0.000	0.059	0.000	0.057	0.000
Used LMS to upload study materials and course-relevant information	0.042	0.000	0.038	0.000	0.052	0.000
Used a messaging platform to send out study materials and/or course-relevant information	0.065	0.000	0.065	0.000	0.040	0.000
Control variables						
Gender (male)	—	—	–0.114	0.000	–0.113	0.000
Form of financing (public-funded)	—	—	–0.002	0.799	0.016	0.058
Field of study (exact sciences)	—	—	0.012	0.158	–0.009	0.320
Field of study (engineering)	—	—	0.044	0.000	–0.012	0.294
Field of study (social sciences)	—	—	0.002	0.874	–0.019	0.080
Year of study	—	—	–0.090	0.000	–0.082	0.000
University 1	—	—	—	—	0.015	0.229
University 2	—	—	—	—	–0.053	0.000
University 3	—	—	—	—	–0.029	0.001
University 4	—	—	—	—	–0.063	0.000
University 5	—	—	—	—	–0.060	0.000
University 6	—	—	—	—	–0.160	0.000
University 7	—	—	—	—	0.002	0.807
University 8	—	—	—	—	–0.059	0.000
University 9	—	—	—	—	–0.014	0.206
University 10	—	—	—	—	–0.010	0.341

Note: Dependent variable: commitment to meet teacher's high requirements (factor value). Independent variables take on "1" if a respondent opts for "Most teachers" or "All the teachers" and "0" if he/she opts for "None of the teachers" or "Some of the teachers". Model 1: $R^2 = 0.016$, adjusted $R^2 = 0.016$, standard error of the estimate = 0.992, Durbin–Watson statistic = 1.905. Model 2: $R^2 = 0.036$, adjusted $R^2 = 0.035$, standard error of the estimate = 0.982, Durbin–Watson statistic = 1.916. Model 3: $R^2 = 0.054$, adjusted $R^2 = 0.052$, standard error of the estimate = 0.973, Durbin–Watson statistic = 1.968

Discussion

Based on the results above, we can assert that our hypothesis on the positive correlation between the use of multimedia and Internet technology by teachers and student engagement in learning and interacting with teachers and peers has been confirmed. Although we assume within our theoretical conception that using multimedia technology affects student behavior, the analysis we performed does not allow us to judge on the cause-effect relationship between these two phenomena. This limitation has to do with the study's empirical design: data was collected via surveys, and respondents' self-reports served as the basis for measuring the use of multimedia technology and student engagement. Nevertheless, the results we obtained can be used in universities' educational policies. In particular, universities should encourage teachers to use multimedia technology in education more actively. The intensity and effectiveness of integrating new technology into teaching practices are primarily determined by the teacher's belief that this technology has an educational value and will improve academic performance [Choudrie, Dwivedi 2005; Cushman, Klecun 2006; Frank et al. 2004; Mooij, Smee 2001; Ottenbreit-Leftwich et al. 2010]. This belief is an important factor in the use of multimedia technology [Mahdizadeh, Biemans, Mulder 2008; Miller et al. 2003]. Thus, to promote the use of advanced technologies, universities should spread information about their positive effects on learning and provide organizational support to teachers by training them to use multimedia technology and implement it in their teaching practices [Keengwe, Kidd, Kyei-Blankan 2009]. Attention should also be paid to a university's academic culture, which is a key prerequisite for accepting and integrating new technology into the learning process [Ferreira 2012].

Although we succeeded in confirming our hypothesis and the correlations between the use of multimedia technology and different styles of student engagement, there is no reason to believe that an essential increase in the percentage of teachers using the web and media opportunities in education will boost student engagement. The regression models constructed and the indicators of the use of advanced technology by teachers only explain a small proportion of student engagement variance. There may also be other variables having a greater impact on student engagement than the use of multimedia technology by teachers. Overall, we can say that these are preliminary findings which may be developed and upgraded during further research.

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Addendum. Descriptive statistics for the variables used in analysis

Table 1. **Distribution of respondents by gender, form of financing, year of study, and university**

	Sample proportion (%)
Gender:	
Male	41.1
Female	58.9
Form of financing:	
Public-funded	73
Tuition fees	21.7
Employer-sponsored	5.3
Year of study:	
1st	29.8
2ns	25.6

	Sample proportion (%)
3rd	20.9
4th	16.6
5th	7.1
Universities	
University 1	11.3
University 2	6.6
University 3	2.4
University 4	7.8
University 5	9.8
University 6	27.4
University 7	3.3
University 8	11.9
University 9	8.6
University 10	4.6
University 11	6.3

Table 2. **Distribution of respondents' assessments of the use of multimedia technology by teachers**

	Answer selected	
	"Most teachers" or "All the teachers" (%)	"None of the teachers" or "Some of the teachers" (%)
Used presentations (in PowerPoint or other programs) in the classroom	57.9	42.1
Used photo or video study materials in the classroom	37.7	62.3
Used LMS to upload study materials and course-relevant information	18.3	81.7
Used a messaging platform to send out study materials and/or course-relevant information	62.6	37.4

Table 3. **Correlation coefficients for the four styles of student engagement**

	Academic engagement	Social engagement	Engagement in academic nonperformance	Commitment to meet teacher's high requirements
Academic engagement	1	0,581***	–0,175***	0,462***
Social engagement	0,581***	1	–0,122***	0,439***
Engagement in academic nonperformance	–0,175***	–0,122***	1	–0,107***
Commitment to meet teacher's high requirements	0,462***	0,439***	–0,107***	1

Note: *** indicates that correlation is significant at confidence level p<0.001

Table 4. **Correlation coefficients for the regression variables**

	Used presentations (in PowerPoint or other programs) in the classroom	Used photo or video study materials in the classroom	Used LMS to upload study materials and course-relevant information	Used a messaging platform to send out study materials and/or course-relevant information
Used presentations (in PowerPoint or other programs) in the classroom	1.000	0.529**	0.268**	0.291**
Used photo or video study materials in the classroom	0.529**	1.000	0.346**	0.271**
Used LMS to upload study materials and course-relevant information	0.268**	0.346**	1.000	0.228**
Used a messaging platform to send out study materials and/or course-relevant information	0.291**	0.271**	0.228**	1.000

Note: ** indicates that correlation is significant at confidence level p<0.01